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Momose

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(54) **PRINTING APPARATUS AND COCKLE REMOVING METHOD**

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B41J 15/16	(2006.01)
B65H 23/02	(2006.01)

(52) **U.S. Cl.**

CPC ***B41J 15/16*** (2013.01); ***B41J 3/4078*** (2013.01); ***B41J 11/0005*** (2013.01); ***B41J 11/005*** (2013.01); ***B41J 11/0015*** (2013.01); ***B65H 23/02*** (2013.01)

(58) **Field of Classification Search**

CPC B41J 2/01; B41J 3/4076; B41J 11/0005; B41J 15/165; B65H 23/022

See application file for complete search history.

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(57) **ABSTRACT**

A printing apparatus includes: a transport unit that has a fixing unit which holds a part of an elongated recording medium and that transports the recording medium to each fixing unit; a recording unit that discharges ink onto the recording medium and performs recording; and a cockle removing mechanism that removes a cockle on the recording medium when the recording medium is sent toward the fixing unit side. The cockle removing mechanism has a first holding unit that holds one end portion of the recording medium in a lateral direction and a second holding unit that holds the other end portion of the recording medium in the lateral direction. The first holding unit and the second holding unit are configured to apply stress to the recording medium in a separating direction from each other.

8 Claims, 3 Drawing Sheets

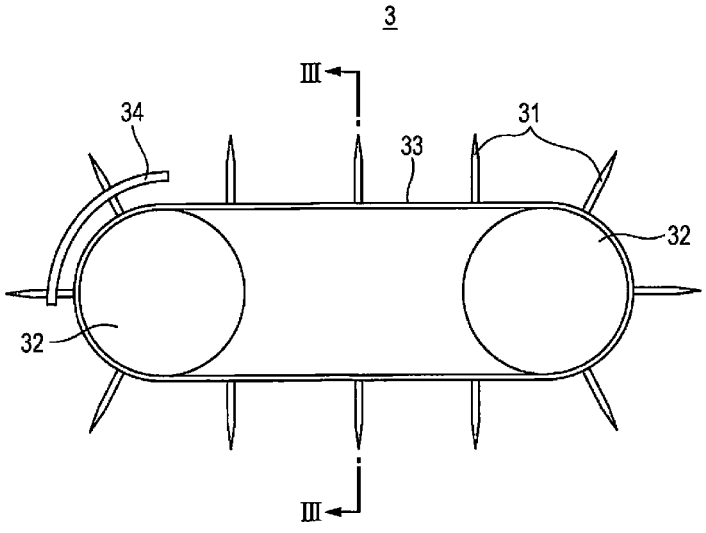

FIG. 1

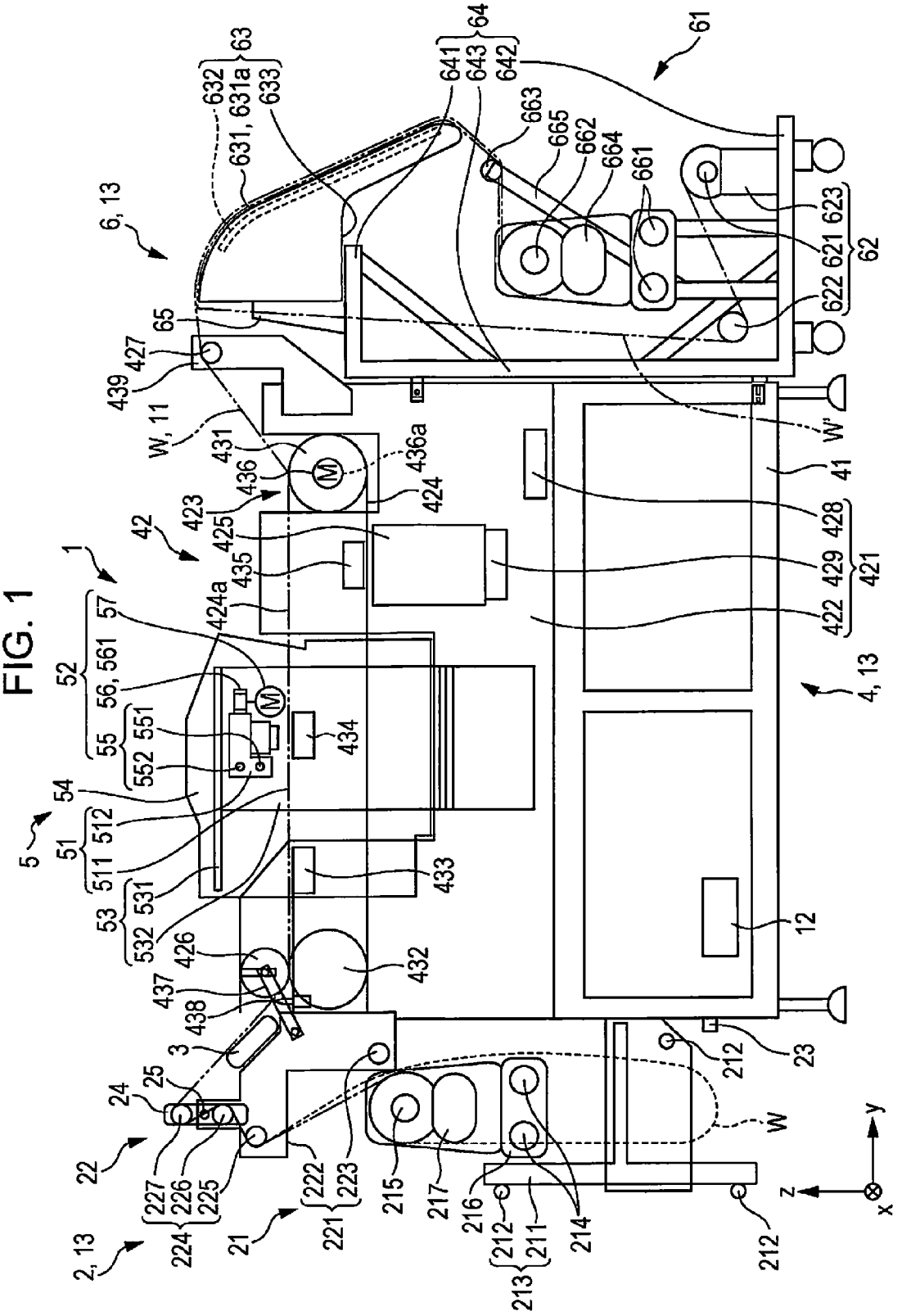
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FIG. 2

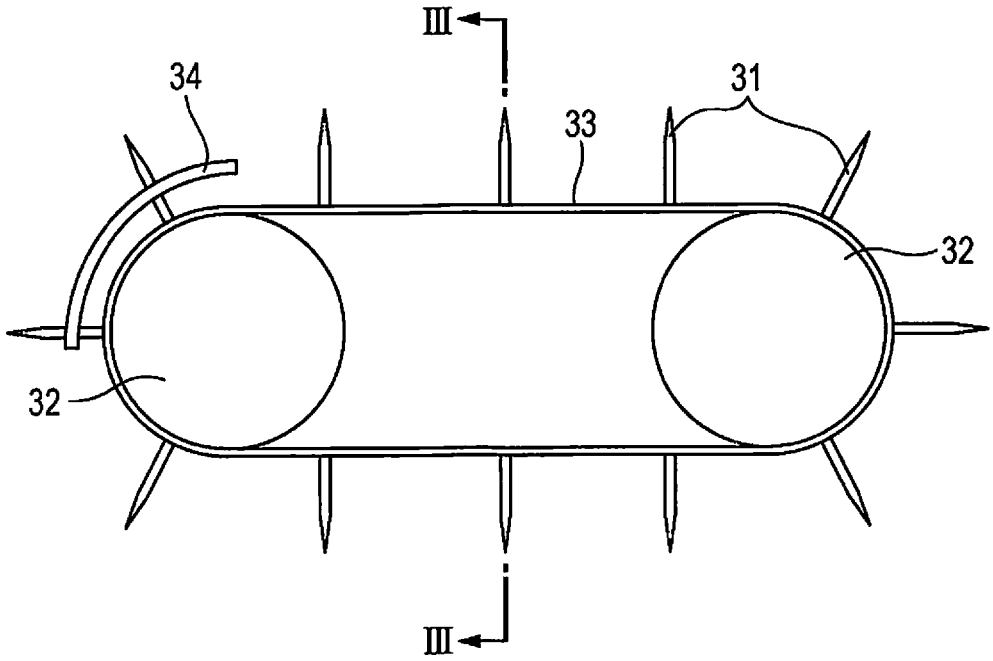


FIG. 3

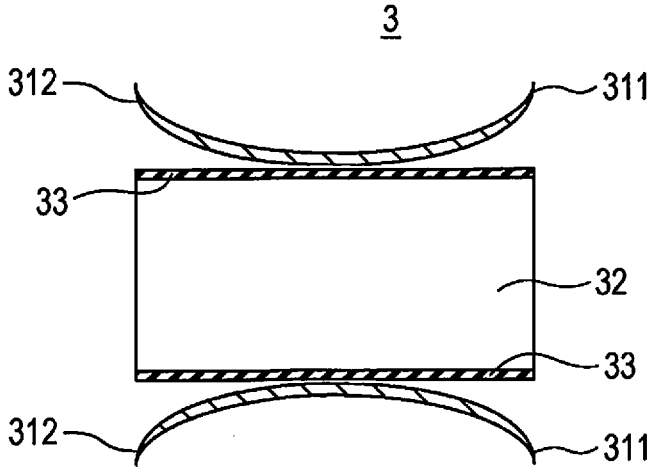


FIG. 4

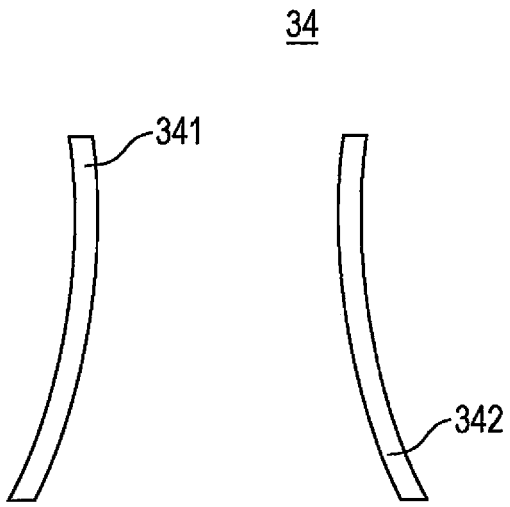
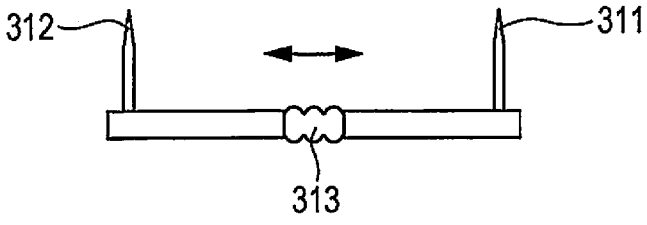


FIG. 5



PRINTING APPARATUS AND COCKLE REMOVING METHOD

BACKGROUND

1. Technical Field

The present invention relates to a printing apparatus and a cockle removing method.

2. Related Art

A printing apparatus is known, in which a recording medium such as a fabric wound in a roll shape is unwound and transported and a recording head performs printing (textile-printing) on the transported recording medium.

In such a printing apparatus, a problem arises in that, when there is a cockle on a recording medium during printing, the quality of printing deteriorates.

In order to solve such a problem, a printing apparatus that includes a cockle stretching mechanism which is configured to have V-shaped (disconnected at the vertex) ribs is disclosed (for example, see JP-A-2002-249976).

However, in the printing apparatus in the related art, it is not possible to achieve a sufficient cockle removal effect. Particularly, in the printing apparatus in the related art, a cockle stretching effects is changed due to a type of recording medium or a transport state of a recording medium and thus, it is difficult to take measures with respect to various types of recording media.

SUMMARY

An advantage of some aspects of the invention is to provide a printing apparatus and a cockle removing method in which it is possible to easily remove a cockle on a recording medium.

The advantage is achieved by the following aspects of the invention.

Application Example 1

According to this application example, there is provided a printing apparatus including: a transport unit that has a fixing unit which holds a part of an elongated recording medium and that transports the recording medium to each fixing unit; a recording unit that discharges ink onto the recording medium and performs recording; and a cockle removing mechanism that removes a cockle on the recording medium when the recording medium is sent toward the fixing unit side. The cockle removing mechanism has a first holding unit that holds one end portion of the recording medium in a lateral direction and a second holding unit that holds the other end portion of the recording medium in the lateral direction. The first holding unit and the second holding unit are configured to apply stress to the recording medium in a separating direction from each other.

In this case, it is possible to easily remove a cockle on the recording medium.

Application Example 2

In the printing apparatus according to the application example, it is preferable that the first holding unit and the second holding unit have a needle shape.

In this case, it is possible to more reliably hold the end portion of the recording medium in the lateral direction and thus, it is possible to more easily remove a cockle on the recording medium.

Application Example 3

In the printing apparatus according to the application example, it is preferable that the first holding unit and the second holding unit have a nipping mechanism; the first holding unit is configured to nip one end portion of the recording medium in the lateral direction and the second holding unit is configured to nip the other end portion of the recording medium in the lateral direction.

In this case, it is possible to more reliably hold the end portion of the recording medium in the lateral direction and thus, it is possible to more easily remove a cockle on the recording medium.

Application Example 4

In the printing apparatus according to the application example, it is preferable that the cockle removing mechanism includes a arcuate member, and the first holding unit and the second holding unit are provided on both end sides of the arcuate member, respectively.

In this case, it is possible to more easily remove a cockle on the recording medium.

Application Example 5

In the printing apparatus according to the application example, it is preferable that a distance adjusting unit that adjusts a distance between the first holding unit and the second holding unit is further included.

In this case, it is possible to more efficiently apply the stress toward the outer sides of the recording medium in a lateral direction and thus, it is possible to more easily remove a cockle on the recording medium.

Application Example 6

In the printing apparatus according to the application example, it is preferable that the stress applied to the recording medium is changed depending on a type of recording medium.

In this case, it is possible to more easily remove a cockle on various types of recording media.

Application Example 7

In the printing apparatus according to the application example, it is preferable that the fixing unit has an endless belt which has an adhesive surface on a side facing the recording medium.

In this case, it is possible to stably transport the recording medium by a simple configuration.

Application Example 8

According to this application example, there is provided a cockle removing method of removing a cockle on an elongated recording medium on which ink is applied and recording is performed during transporting of the recording medium, the method including: applying stress to the outer sides of the recording medium in a lateral direction, with respect to the recording medium.

In this case, it is possible to easily remove a cockle on the recording medium.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

FIG. **1** is a side view schematically illustrating an exemplary embodiment of a printing apparatus according to the invention.

FIG. **2** is a side view schematically illustrating a cockle removing mechanism of the printing apparatus in FIG. **1**.

FIG. **3** is a cross-sectional view of the cockle removing mechanism in FIG. **2** when taken along line III-III.

FIG. **4** is a plan view of a distance adjusting mechanism (cam mechanism) which is included in the cockle removing mechanism in FIG. **2**.

FIG. **5** is a view schematically illustrating another embodiment of a cockle removing mechanism.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

Hereinafter, a printing apparatus and a cockle removing method of the invention will be described in detail based on an exemplary embodiment illustrated in the reference drawings.

Printing Apparatus

FIG. **1** is a side view schematically illustrating an exemplary embodiment of a printing apparatus according to the invention. FIG. **2** is a side view schematically illustrating a cockle removing mechanism of the printing apparatus in FIG. **1**. FIG. **3** is a cross-sectional view of the cockle removing mechanism in FIG. **2** when taken along line III-III. FIG. **4** is a plan view of a distance adjusting mechanism (cam mechanism) which is included in the cockle removing mechanism in FIG. **2**. Hereinafter, for convenience of description, a depth direction from the paper surface in FIG. **1** is referred to as an "x-axis direction", a right-left direction is referred to as a "y-axis direction", and a vertical direction is referred to as a "z-axis direction".

A printing apparatus **1** illustrated in FIG. **1** prints (textile-prints) a pattern or the like on a fabric (original fabric) which is removed and supplied in a so-called reel-to-reel manner using dedicated dye ink by an ink jet method. In the printing apparatus **1**, a direction (horizontal direction) in which a recording medium W which is a fabric is transported corresponds to the y-axis direction, a direction orthogonal to the y-axis direction corresponds to the x-axis direction, and the perpendicular direction corresponds to the z-axis direction.

The printing apparatus **1** includes an unwinding section **2** that unwinds and feeds the recording medium W wound in a roll shape, a cockle removing mechanism **3** that removes a cockle of the unwound recording medium W, an apparatus main body **4** that feeds the unwound recording medium W along a feeding path **11** so as to printing is performed, a printing mechanism section (recording unit) **5** that is disposed on the upper side of the apparatus main body **4** and performs printing on the recording medium W by the ink jet method in cooperation with the apparatus main body **4**, a winding section **6** that winds an collects the recording medium W on which printing is performed by the printing mechanism section **5**, downstream in the feeding direction from the apparatus main body **4**, and a controller (control unit) **12** that controls operations of these sections. In the printing apparatus **1**, a transport mechanism section (transport unit) **13** is configured to have the unwinding section **2**, the cockle removing mechanism **3**, the apparatus main body **4**, and the winding section **6**, and transports the elongated recording medium W in the longitudinal direction, that is, y-axis direction.

The apparatus main body **4** includes a main body base **41** that is configured of assembled steel materials, and a medium feeding mechanism **42** that is supported by the main body base **41** and intermittently feeds the recording medium W through belt transport in the y-axis direction.

The printing mechanism section **5** includes a carriage unit **51** that has an ink jet head **511** and a head moving mechanism **52** that causes the carriage unit **51** to reciprocate in the x-axis direction.

The unwinding section **2** includes an unwinding unit **21** that unwinds the recording medium W and a tensioning unit **22** that causes looseness of the unwound recording medium W to disappear.

The winding section **6** includes a winding unit **61** that winds the recording medium W, a slip sheet unit **62** that supplies a slip sheet W' to the winding unit **61**, and a heater unit **63** that vaporizes a solvent (water) of the dye ink infiltrated into the recording medium W before the recording medium W is wound. These units are configured to be mounted on the winding section base **64**.

In the recording medium W (fabric) unwound from the unwinding unit **21**, the looseness disappears by the tensioning unit **22** through stretching and then, the recording medium is fed to the cockle removing mechanism **3**.

A cockle on the recording medium W fed to the cockle removing mechanism **3** is removed and then, is fed to the medium feeding mechanism **42**. The recording medium W fed to the medium feeding mechanism **42** is adhered to a surface and is transported on a belt. In this belt transport, the recording medium W is intermittently fed in the y-axis direction (sub-scanning), concurrently the carriage unit **51** reciprocates in the x-axis direction and then, ink discharge from the ink jet head **511** is performed (main scanning).

In this manner, after the printing is performed, a printing-finished portion (textile-printing finished portion) of the recording medium W is sent to the winding section **6** from the medium feeding mechanism **42**. In the winding section **6**, the slip sheet W' is continuously supplied from the slip sheet unit **62** to the recording medium W sent from the medium feeding mechanism **42** and the recording medium W and the slip sheet W' are superposed and are fed to the heater unit **63**. In the heater unit **63**, the recording medium W is heated along with the slip sheet W' and the solvent (water) of the dye ink is vaporized. In this manner, the textile-printing finished recording medium W after subjected to a dry treatment is wound around the winding unit **61** along with the slip sheet W'.

The unwinding unit **21** includes a pair of right and left (x-axis direction) T-shaped frames **211** fixed to the main body base **41** described above, an unwinding frame **213** that is formed of a plurality of rod-like frames **212** straddling across the pair of T-shaped frames **211**, two unwinding-side rod bases **214** that are slidably supported by the pair of T-shaped frames **211** in the x-axis direction and extend in the x-axis direction, and a pair of unwinding-axis protrusions (feeding roll) **215** which are slidably supported by the two unwinding-side rod bases **214**. A tip portion of each of the unwinding-axis protrusions **215** is formed to have a truncated cone shape, the tip portions of the pair of unwinding-axis protrusions **215** are fitted to unwinding cores of the roll-shaped recording medium W by widthwise closeness to each other corresponding to the width of the recording medium W and horizontally supports the recording medium W. In this support state, the recording medium W is sent toward the medium feeding mechanism **42** (transport belt **424**) side.

The pair of unwinding-axis protrusions **215** are configured to integrally move in a right-left direction (width direction of the recording medium W) by a motor-driven width moving unit **216** via two unwinding-side rod bases **214**.

In addition, a motor-driven rotating unit **217** is assembled on one of the pair of unwinding-axis protrusions **215** and the pair of unwinding-axis protrusions **215** are caused to rotate to perform unwinding by the rotating unit **217** such that the

recording medium W is unwound. Further, a reflection type optical sensor **23** that detects presence or absence of the recording medium W unwound from the unwinding unit **21** is provided below the unwinding unit **21**.

According to the present embodiment, a tension mode in which constant tension is applied to the recording medium W and the recording medium W is unwound and a looseness mode in which tension is as small as possible and unwinding is performed are provided and modes are switched according to a type of recording medium W. The tension mode and the looseness mode are configured to be switchable on an operation screen (not illustrated) provided in the printing mechanism section **5** using a graphical user interface (GUI) button.

The tension mode is performed for a normal fabric (recording medium W) having low elasticity as a target and, in this case, for example, the controller **12** configured of a personal computer controls the rotating unit **217** such that predetermined tension is applied to the recording medium W and the recording medium is unwound toward a first roller **225**. To be more specific, the controller **12** controls torque of a motor of the rotating unit **217** and thereby, drives the rotating unit **217** during a feeding operation of the recording medium W by the medium feeding mechanism **42** such that the recording medium W is unwound, and drives the rotating unit **217** during a feeding stop of the recording medium W by the medium feeding mechanism **42** such that the recording medium W is slightly rewound. Accordingly, the recording medium W is fed in a state in which tension is applied to the recording medium W between the unwinding unit **21** and the tensioning unit **22**.

The looseness mode is performed for a fabric (recording medium W) having high elasticity such as a stocking, in this case, the controller **12** controls the rotating unit **217** (in FIG. **1**, the recording medium W on the loosed portion is illustrated in a dashed line) such that the unwound recording medium W is temporarily loose downward and is fed to the tensioning unit **22**. That is, when an amount of looseness of the recording medium W becomes small in response to the feeding operation of the recording medium W by the medium feeding mechanism **42** and optical sensor **23** provided on the lower side of the unwinding unit **21** detects "absence" of the recording medium W, the controller **12** positively drives the rotating unit **217** and the rotating unit **217** rotate so as to unwind the recording medium W and thereby, when the amount of looseness in increased and the optical sensor **23** detects "presence" of the recording medium W, the controller **12** stops the driving of the rotating unit **217**. The recording medium W is fed by the control of the amount of looseness, the recording medium W between the unwinding unit **21** and tensioning unit **22** are appropriately loosened.

The tensioning unit **22** includes a pair of right and left (x-axis direction) L-shaped frames **222** fixed to a side frame **422** of the medium feeding mechanism **42**, a looseness removing frame **221** that is formed of a rod frame **223** straddling across the pair of L-shaped frames **222**, and a roller group **224** rotatably supported by both sides of the pair of L-shaped frames **222**. The roller group **224** includes a first roller **225**, a second roller **226**, and a third roller **227** which are disposed in the order from upstream side in the feeding direction so as to bend, at a plurality of places, the feeding path **11** of the recording medium W sent in from the unwinding unit **21**, and is configured to have rollers of which a coefficient of friction is high.

The recording medium W unwound from the unwinding unit **21** makes a U-turn or the like at the first roller **225** and reaches the second roller **226** and the third roller **227**. The second roller **226** and the third roller **227** are disposed to be close vertically and are rotatably supported by a pair of bearing units **24** of which both end portions are integrally formed. In addition, the bearing units **24** are rotatably supported by the L-shaped frames **222** and an angle adjusting unit **25** that adjusts vertical disposition angle of the second roller **226** and the third roller **227** are assembled to the bearing unit **24**.

The recording medium W that passes the second roller **226** and the third roller **227** has a changed S-shaped path; however, the "S"-shaped curve is changed and adjusted depending on types of recording media and the moderate tension can be applied to each of the recording medium W. Accordingly, the partial looseness or cockle of the recording medium W is removed and is fed to the medium feeding mechanism **42**. It is preferable that the first roller **225**, the second roller **226**, and the third roller **227** have a convex portion such that a component of a force acts toward the outer side from the center.

As illustrated in FIGS. **2** and **3**, the cockle removing mechanism **3** includes a pair of rollers **32**, an endless belt **33** that crosses over the pair of rollers **32**, a plurality of arcuate members **31** fixed to the belt **33**, and a distance adjusting unit **34** that adjusts the distance of both ends of the arcuate member **31**.

The endless belt **33** is configured to rotate by following the transport of the recording medium W and is configured so as to rotate in the clockwise direction in FIG. **2**.

The arcuate member **31** has an arcuate shape and includes a first holding unit **311** and a second holding unit **312** on both ends thereof.

The first holding unit **311** and the second holding unit **312** have a needle shape. A needle-like tip of the first holding unit **311** punctures the vicinity of one end of the recording medium W and holds the one end of the recording medium W. In addition, a needle-like tip of the second holding unit **312** punctures the vicinity of the other end of the recording medium W and holds the other end of the recording medium W.

The distance adjusting unit **34** is provided so as to include positions where the recording medium W comes into contact with the arcuate member **31**.

The distance adjusting unit **34** is configured to have a rail **341** and a rail **342**.

An space between the rail **341** and the rail **342** are configured to become greater on the side of the lower end (upstream in the movement direction of the arcuate members **31**) in FIG. **4**, and to become narrower on the side of the upper end (downstream in the movement direction of the arcuate members **31**) in FIG. **4**.

The space between the rail **341** and the rail **342** on the upstream side in the movement direction of the arcuate members **31** is configured to be slightly greater than the space between the first holding unit **311** and the second holding unit **312** of the arcuate member **31** in a state in which no load is applied. The space between the rail **341** and the rail **342** on the downstream side in the movement direction of the arcuate member **31** is configured to be slightly narrower than the space between the first holding unit **311** and the second holding unit **312** of the arcuate member **31** in a state in which no load is applied.

As employing such a configuration, when the arcuate member **31** passes between the rail **341** and the rail **342**, the space between the first holding unit **311** and the second holding unit **312** becomes narrower by the distance adjusting unit **34**. In a state in which the first holding unit **311** and the second holding unit **312** becomes closer, the first holding unit **311** and the second holding unit **312** come into contact with the recording medium W and hold the vicinities of the end of the recording medium W, respectively. In this state, when the

recording medium W is farther transported and passes the arcuate member **31** and the distance adjusting unit, the first holding unit **311** and the second holding unit **312** move in a separating direction from each other because the arcuate member **31** enters into a state in which no load is applied. Accordingly, the stress is applied to the outer sides of the recording medium W in the width direction (lateral direction) and the cockle of the recording medium W is removed.

Depending on the type of recording medium W, a material of the arcuate member **31** is changed and the space between the rail **341** and the rail **342** in the vicinity of an exit of the arcuate member **31** is changed. Then, it is possible to change the stress applied to the recording medium W.

The medium feeding mechanism **42** includes a main body frame **421** that has a pair of right and left (x-axis direction) side frames **422** mounted and fixed on the main body base **41**, a belt transport unit **423** that is supported by the pair of side frame **422** and has an endless transport belt (endless belt) **424**, and a belt cleaning unit **425** disposed on the lower side from the belt transport unit **423**. In addition, the medium feeding mechanism **42** includes a press roller **426** facing the belt transport unit **423** on the upstream side from the upper side and a separation roller **427** that is disposed obliquely upward with respect to the belt transport unit **423** on the upstream side.

The main body frame **421** has the pair of side frames **422** which are configured of thick plate materials and a pair of front and rear (y-axis direction) connection frames **428** that connect the side frame **422** and the main body frame **421** is mounted and fixed to the main body base **41** at a portion of the pair of side frames **422**. In addition, the main body frame **421** has a support frame **429** which is positioned between the pair of connection frames **428**, is coupled with the pair of side frame **422**, and supports the belt cleaning unit **425** described above. In each of the side frames **422**, a notch portion to which the belt transport unit **423** is attached or a notch portion to which the printing mechanism section **5** is attached are appropriately provided, and in addition, an opening is formed, through which the belt cleaning unit **425** is checked.

The belt transport unit **423** includes a drive pulley **431** positioned upstream in the transport direction, a driven pulley **432** that is positioned upstream in the feeding direction, and an endless transport belt **424** which is cross-linked between the drive pulley **431** and the driven pulley **432**. In addition, the belt transport unit **423** includes a first guide plate **433** that is positioned around the driven pulley **432** and guides travelling of the transport belt **424**, a second guide plate **434** that is positioned immediately below the printing mechanism section **5** and guides the travelling the transport belt **424**, and a third guide plate **435** that is positioned immediately below the support frame **429**, and guides the travelling of the transport belt **424** rounded to the back side.

The first guide plate **433** and the second guide plate **434** cross-links between the pair of side frames **422** in a state of being disposed such that the surfaces are flush (the same horizontal surface) to each other, and thus, function as a part of the main body frame **421**. In addition, the first guide plate **433** guides the (upper) transport belt **424** so as to travel horizontally immediately after the transport belt **424** is separated from the driven pulley **432** and the second guide plate **434** guides the transport belt **424** that is positioned in a printing region such that looseness does not occur on the top side. Thus, the transport belt **424** positioned immediately above the second guide plate **434** functions as a platen. Further, the third guide plate **435** guides the transport belt **424** that receives an upthrust force by the belt cleaning unit **425** so as to be pressed down. The transport belt **424** immediately after (on the lower side) being separated from the drive pulley **431** travels horizontally. That is, the transport belt **424** travels horizontally at a position where cleaning is performed on the belt by the belt cleaning unit **425**.

The drive pulley **431** and the driven pulley **432** are rotatably supported by the pair of side frames **422** via a dedicated bearing and a transport motor (motor) **436** that causes the transport belt **424** to intermittently travel is connected to one end of the drive pulley **431** in the axis.

An encoder **436***a* is installed in the transport motor **436**. A rotating amount detected by the encoder **436***a* is adjusted and thereby, it is possible to reliably send the transport belt **424** intermittently. In addition, it is possible to reliably detect that the recording medium W is being transported, based on the detected rotating amount, that is, based on whether or not the transport motor **436** rotates.

The transport belt **424** is configured of a special wide width belt to have an outer circumferential surface (fixing unit) **424***a*, that is, a surface on the side facing the recording medium W is adhesive (adhesive treatment). The outer circumferential surface **424***a* corresponds to the fixing unit that holds an intermediate portion of the recording medium W in the longitudinal direction. The recording medium W is held by the adhesion of the outer circumferential surface **424***a* (fixing unit) and is transported by the transport belt **424** which drives in this state. Accordingly, the recording medium W is intermittently transported immediately below the printing mechanism section **5** without an occurrence of curling or the like and recording is performed by ink discharged from the printing mechanism section **5**.

The press roller **426** that presses the recording medium W sent from the cockle removing mechanism **3** to adhere to the transport belt **424** is disposed on the upper side of the driven pulley **432**. The press roller **426** is rotatably supported by tips of a pair of support arms **437** rotatably supported by the side frame **422**. In addition, the press roller **426** has a predetermined elasticity and a self-weight and presses the recording medium W against the transport belt **424** by the self-weight at a position immediately above the driven pulley **432**. That is, the press roller **426** and the driven pulley **432** nip the transport belt **424** and function as nip rollers, and cause the recording medium W to continuously adhere to the travelling transport belt **424**. An air cylinder **438** that rotates the support arms **437** is connected to an intermediate position of each of the support arms **437**. A pair of the air cylinders **438** are synchronously driven and thereby, the press roller **426** is pulled apart from the transport belt **424**.

A separation roller **427** that peels the recording medium W from the transport belt **424** after printing and sends the recording medium to the winding section **6** is disposed obliquely upward from the drive pulley **431**. The separation roller **427** is rotatably supported by a pair of sub frames **439** extending from the side frame **422**. In this case, the separation roller **427** relatively peels the recording medium W from the transport belt **424** that circles the drive pulley **431** and rounds to the back side but, in the actual operation, a peeling force from the transport belt **424** varies depending on types of recording media W. Therefore, depending on the types, the peeling is started at a position where the transport belt **424** starts circling and the peeling is performed at a position where the circling is performed to some extent. Here, when the peeling point is rounded to the back side, there is a concern that the recording medium W is caught in the transport belt **424**.

According to the present embodiment, an angle of the recording medium W sent from the transport belt **424** and to the separation roller **427** is position-detected, the winding unit **61** is driven to perform winding based on the detection

result of the position detection, and the point of peeling is prevented from rounding to the back side of the transport belt **424**.

Since yarn waste or dust is attached on the transport belt **424** having adhesiveness, cleaning of the transport belt **424** is regularly performed by the belt cleaning unit **425**. The belt cleaning unit **425** is supported by the support frame **429** on the lower side of the transport belt **424** and extends in the x-axis direction so as to cross the transport belt **424**. Eventually, cleaning solution remaining on the transport belt **424** is wiped with a waste cloth.

The printing mechanism section **5** includes a printer frame **53** that extends in the x-axis direction so as to straddle the feeding path **11** (belt transport unit **423**), a head moving mechanism **52** that is supported by the printer frame **53**, carriage unit **51** that is mounted in the head moving mechanism **52** and reciprocates in the x-axis direction, and a printer cover **54** that covers all the parts. Although not illustrated particularly, the carriage unit or the cleaning unit that maintains the ink jet head **511** are mounted in the printing mechanism section **5**. In the printing mechanism section **5**, since various recording medium W has a thickness thereof and a width, a so-called paper gap (work gap) is adjusted by moving the entire printing mechanism section **5** vertically with respect to the apparatus main body **4** (medium feeding mechanism **42**).

The printer frame **53** includes a beam-like frame **531** formed of a metal plate which extends in the x-axis direction and a pair of standing frames **532** formed of a metal plate which support the beam-like frame **531** by both end portions thereof. The side frame **422** described above is supported by a portion of the pair of standing frames **532**. The printer cover **54** is attached to the printer frame **53**.

The carriage unit **51** includes the ink jet head **511** that has a plurality of colors of nozzle rows for a color printer and a carriage **512** that holds the ink jet head **511** so that a nozzle surface faces downwards. The various colors of dye ink supplied to the nozzle rows are supplied from an ink tank of an off-carriage.

The head moving mechanism **52** includes a carriage guide **55** that holds the carriage unit **51** by one side and supports the carriage unit **51** so as to be slidable in the x-axis direction, a belt conveying mechanism **56** that causes the carriage guide **55** to reciprocate, and a carriage motor **57** that drives the belt conveying mechanism **56**. The carriage guide **55** is formed of a lower main guide **551** and an upper sub guide **552**. The lower main guide **551** and the upper sub guide **552** are supported by the pair of standing frames **532** at both ends thereof. The belt conveying mechanism **56** includes a timing belt **561** and a part of the timing belt **561** is fixed to the carriage unit **51** (carriage **512**).

When the timing belt **561** is caused to perform forward or reverse travelling by the carriage motor **57**, the carriage unit **51** is guided to the carriage guide **55** and reciprocates in the x-axis direction. The movement position of the carriage guide **55** is detected by a linear encoder and various colors of dye inks are selectively discharged from the ink jet head **511** based on the detection result and print data. Accordingly, the printing (textile-printing) is performed on the recording medium W.

The winding section **6** includes the winding section base **64** detachably connected to the main body base **41** in the y-axis direction, the heater unit **63** supported by the upper portion of the winding section base **64**, and the winding unit **61** and the slip sheet unit **62** which are supported by the lower portion of the winding section base **64**. The textile-printed recording medium W may be wound by the following two methods; one method in which the thick recording medium W in which the ink does not permeate to the back surface is wound as is and the other method in which a thin recording medium W in which the ink is likely to permeate to the back surface is wound with the slip sheet W' which overlaps the recording medium. The winding section **6** according to the present embodiment is designed to be applied to both methods. Hereinafter, the description of employing the latter is provided.

The winding section base **64** includes a horizontal upper frame portion **641**, a horizontal lower frame portion **642**, and a perpendicular frame portion **643** to which the horizontal upper frame portion **641** and the horizontal lower frame portion **642** are connected, respectively, and is configured to have extruded aluminum members assembled horizontally and vertically. A portion of the perpendicular frame portion **643** is detachably connected to the main body base **41**.

The heater unit **63** includes a radiating plate **631** that has an arc-shaped radiating surface **631***a*, a heater **632** that is internally attached to the radiating plate **631**, and a pair of right and left support plates **633** that are provided on the inner right and left ends of the radiating plate **631** and have an elephant trunk shape. In addition, the heater unit **63** (support plates **633**) is attached to the horizontal upper frame portion **641** by the right and left fixing member **65** provided in the horizontal upper frame portion **641** in a state in which the upper half thereof is mounted on the horizontal upper frame portion **641**. The upper end of the radiating plate **631** approaches the separation roller **427** and is disposed at a slightly lower position than the separation roller **427**. In addition, the upper end of the radiating plate **631** is formed to be bent in a downward arc shape such that the slip sheet W' guided in from the lower side changes the path.

The recording medium W which passed the separation roller **427** is superposed with the slip sheet W' which is sent from the lower side to the upper end of the radiating plate **631** and is guided to the arc-shaped outer surface (radiating surface **631***a*) of the radiating plate **631** and then, is sent to the lower side. The recording medium W and the slip sheet W' which come into sliding contact with the radiating surface **631***a* and are sent in the vertical direction are continuously heat by the heater **632**. Through the heating, the solvent (water) of the dye ink infiltrated into the recording medium W evaporates and dye is fixed on the fabric.

The slip sheet unit **62** includes a slip sheet roller **621** that unwinds the roll-shaped slip sheet W' and a guide bar **622** that changes the path of the unwound slip sheet W' toward the upper end of the radiating plate **631**. The guide bar **622** is fixed to a diagonal member that connects the horizontal lower frame portion **642** to the perpendicular frame portion **643**. In addition, a slip sheet roller **621** is supported on a front section of the horizontal lower frame portion **642** via the pair of bearing units **623** which assembles a control mechanism. The slip sheet W' is unwound by the pair of bearing units **623** without looseness.

Similar to the unwinding unit **21**, the winding unit **61** includes two winding side rod bases **661** that is supported by an intermediate portion in the front-rear direction of the horizontal lower frame portion **642** and extends in the x-axis direction and a pair of winding-axis protrusions **662** slidably supported by the two winding side rod bases **661**. In addition, the winding unit **61** includes a tension roller **663** that is positioned on the feeding path **11** between the lower end of the radiating plate **631** and the pair of winding-axis protrusions **662** and applies tension to the recording medium W and the slip sheet W'.

The tip of the winding-axis protrusion **662** is formed to have a truncated cone shape, the tip portions of the pair of

winding-axis protrusions **662** are fitted to winding cores around which the recording medium W is wound by width-wise closeness to each other corresponding to the width of the recording medium W and horizontally supports the recording medium W. A motor-driven rotating unit **664** is assembled on one of the pair of winding-axis protrusions **662** and the pair of winding-axis protrusions **662** are caused to rotate and the recording medium W and the slip sheet W' are wound concurrently. The rotating unit **664** is controlled in the vicinity of the separation roller **427** as described above based on angle detection of the recording medium W which is sent to the separation roller **427**.

The tension roller **663** is rotatably supported by tips of a pair of rotation arms **665** rotatably supported by a rear portion of the horizontal lower frame portion **642**. The tension roller **663** comes into rolling contact with t with the slip sheet W' side of the recording medium W which is wound around the winding core and the slip sheet W' and biases the recording medium W and the slip sheet W' by the self-weight thereof downward by rotating. Accordingly, appropriate tension is applied to the recording medium W and the slip sheet W' and the recording medium W and the slip sheet W' are wound around the winding cores so as to be tightly wound.

The controller **12** is electrically connected to the transport mechanism section **13**, the printing mechanism section **5**, and the like, and has a function of controlling the operations of the sections.

As above, the embodiments of the printing apparatus and the cockle removing method of the invention illustrated in the drawings are described; however, the invention is not limited thereto and it is possible to replace components which configures the printing apparatus with components in an arbitrary configuration that can exhibit the same function. In addition, an arbitrary component may be added.

In addition, according to the embodiment described above, the cockle removing mechanism is described to include the arcuate member; however, the configuration is not limited thereto and the cockle removing mechanism may have a configuration in which, for example, as illustrated in FIG. **5**, a member that includes the first holding unit **311** and a member that includes the second holding unit **312** are connected to each other by an elastic member **313** that can be elastic in an arrow direction in the drawing.

In addition, according to the embodiments described above, the first holding unit and the second holding unit are described to have a needle shape; however, the configuration is not limited thereto and the first holding unit and the second holding unit may have a shape by which the end of the recording medium in the lateral direction is pinched.

The entire disclosure of Japanese Patent Application No. 2014-065413, filed Mar. 27, 2014 is expressly incorporated by reference herein.

What is claimed is:

1. A printing apparatus comprising:

a transport unit that has a fixing unit which holds a part of an elongated recording medium and that transports the recording medium;

a recording unit that discharges ink onto the recording medium; and

a cockle removing mechanism that removes a cockle on the recording medium when the recording medium is sent toward the fixing unit side,

wherein the cockle removing mechanism has a first holding unit that holds one end portion of the recording medium in a lateral direction, a second holding unit that holds the other end portion of the recording medium in the lateral direction, and a moving unit configured to move the first holding unit and the second holding unit in conjunction with transportation of the recording medium by the transport unit,

wherein the first holding unit and the second holding unit are configured to apply stress to the recording medium in a separating direction from each other as a distance between the first holding unit and the second holding unit increases while the first holding unit and the second holding unit are moved in conjunction with the transportation of the recording medium and while the first holding unit holds the one end portion of the recording medium in the lateral direction and the second holding unit holds the other end portion,

wherein the moving unit includes a pair of rollers and an endless belt that crosses over the rollers, and the first holding unit and the second holding unit are disposed on the endless belt.

2. The printing apparatus according to claim **1**,

wherein the first holding unit and the second holding unit have a needle shape.

3. The printing apparatus according to claim **1**,

wherein the first holding unit and the second holding unit have a nipping mechanism, and

wherein the first holding unit is configured to nip one end portion of the recording medium in the lateral direction and the second holding unit is configured to nip the other end portion of the recording medium in the lateral direction.

4. The printing apparatus according to claim **1**, wherein the cockle removing mechanism includes an arcuate member, and

wherein the first holding unit and the second holding unit are provided on both end sides of the arcuate member, respectively.

5. The printing apparatus according to claim **1**, further comprising:

a distance adjusting unit that adjusts the distance between the first holding unit and the second holding unit.

6. The printing apparatus according to claim **1**,

wherein the stress applied to the recording medium is changed depending on a type of recording medium.

7. The printing apparatus according to claim **1**,

wherein the fixing unit has an endless belt which has an adhesive surface on a side facing the recording medium.

8. A cockle removing method of removing a cockle on an elongated recording medium on which ink is applied during transporting of the recording medium, the method comprising:

moving a first holding unit and a second holding unit in conjunction with transportation of the recording medium with a pair of rollers and an endless belt which crosses over the rollers and on which the first holding unit and the second holding unit are disposed; and

applying stress to the outer sides of the recording medium in a lateral direction, with respect to the recording medium as a distance between the first holding unit and the second holding unit increases while the first holding unit and the second holding unit are moved in conjunction with the transportation of the recording medium and while the first holding unit holds one end portion of the recording medium in the lateral direction and the second holding unit holds the other end portion.

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